Guidance Information - Bulletin No. 1006

National Fireproofing Contractors Association

Ensuring Accurate Fireproofing Density Measurements

Contractors are often faced with the need to resolve field density measurements that fall below the minimum density required by the applicable UL design.

Prior to 1993, the standard field method of determining the density of in place fireproofing was to mark out a one square foot area of in place product and measure the thickness at multiple points. The material in the one square foot area was then removed, dried and weighed. Using the dry weight of the removed material and the volume calculated from the average thickness measurement of the one foot square, the dry density could be calculated. With this method, the variation in the spray texture thickness as well as the ability to measure a true average, introduced a large degree of variation and error in the calculated dry densities. In the past, this error rarely caused a problem as most dry densities were 18-19 pcf, which is well above UL minimum requirements. The old ASTM E-605 “thickness measurement dependant” density test method resulted in repeated errors, jobsite delays and lost time for both applicators and manufacturers.

In 1991, a study was funded at Underwriters Laboratories to determine if a “Volume Displacement” method of measuring sample volume would lead to more accurate measurement results. UL concluded that the displacement method did result in a more reliable and accurate determination of the density of irregularly shaped objects such as sprayed fireproofing.

With the results of this study and with the agreement of other manufacturers of sprayed fire protection products, ASTM adopted this volume displacement method as an alternate to the direct thickness method of determining dry density of sprayed fireproofing products. The original “bead” used to measure the volume displaced by the sample was lead shot. For environmental reasons steel shot replaced lead. More recently, unexpanded polystyrene bead has also been accepted as an alternate to steel and lead shot. The use of glass bead also results in accurate results, but is currently not allowed in the test standard. A request has been submitted to the ASTM E-605 committee to adopt glass bead as an alternate to lead shot and polystyrene bead.

Several vendors market density test kits and are listed on page 3. These test kits can be used with the displacement option within the ASTM E-605 test method to attain the most accurate measurement of the dry in place density of spray fire resistance materials. Note that the sample size (step #3 below) is critical to getting accurate results. While the sample size must be at least $131cm^3$, larger samples give more accurate results. A sample that is nearly as big as the test beaker, but allowing beads to fall freely around the sample, is the ideal size. Multiple small samples may be combined in the beaker to improve accuracy, provided there is space for the beads to flow freely around the sample.

Due to the inaccuracy of the direct thickness measurement method, a request has been submitted to the ASTM E-605 committee to adopt the displacement method as the preferred standard with consideration to possibly eliminate the direct thickness method from the standard.
Where low densities are reported by third party testing agencies, manufacturers continue to work with the testing agency and applicator to demonstrate and train to this displacement method. Virtually all field density issues are resolved when this method is introduced.

Following is a written procedure to determine the SFRM density using the volume displacement procedure. View a proper inspection and testing procedure on the NFCA web site at www.nfca-online.org under the "ICC Inspector" section.

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Volumetric Displacement Method

Apparatus:	Moisture meter	Funnel
	Translucent round pan	400 ml smooth wall beaker
	Bench scale with accuracy to 0.1 g	1 liter plastic cup
	Displacement beads – polystyrene, lead shot or glass	Spatula
	250 cc graduated cylinder	

Procedure:

1. Prior to density testing, the applied SFRM must be cured. Measure the moisture content of the sample using a plaster scale moisture meter. Consult the manufacturers specification for maximum percent moisture.
2. Determine the sample location and test frequency by consulting Chapter 17 of the International Building Code (IBC
3. Remove a sample of applied SFRM sufficient to fit into the 400 ml beaker. Minimum sample size is 8 in^3 (131 cm^3). The sample shall be of uniform size with no uneven edges.
4. Weigh the sample on the bench scale to the nearest 0.1 g.
5. Place the 400 ml beaker into the translucent round pan. Using the funnel, pour displacement beads into the beaker until overflow. Do not compact the displacement beads by shaking or tapping the beaker.
6. Screed off excess beads from the top of the beaker using the straight edged spatula. Collect the excess beads in the round pan and return to the displacement bead container. Place the clean round pan under the filled beaker.
7. Pour the displacement beads from the beaker, into the 1 liter cup, leaving sufficient beads to cover the bottom of the beaker.
8. Center the sample into the beaker making sure no edges touch the beaker sides.
9. Using the funnel, pour the beads from the 1 liter cup back into the beaker. Cover the sample and fill the cylinder to overflow. Screed the excess displacement beads into the round pan.
10. Collect the overflow and screed the displacement beads from the shallow pan into a 250 cc graduated cylinder. Do not compact the beads by tapping the graduated cylinder. Record the volume of the displaced beads in cubic centimeters. This is the volume displace by the sample.
11. Calculate the density of the sample using the following equation:

$$\mathbf{D = W \times 62.43 / V}$$

D = density (pcf)
W= weight of sample (g)
V = volume of sample (cm^3)

12. Report the density of the sample as the average of three density determinations.

Test Kit Vendors:

Isolatek Int.	Nathan Kimmel Co.
Customer Service	PO Box 21462
41 Furnace Street	Los Angeles, CA 90021
Stanhope, NJ 07857	213-627-8556
800-631-9600	